REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specially, claims 1, 2, 4 and 5 have been amended to recite that, in addition to the components previously set forth, the steel includes 0.045% or less of P, and 0.030% or less of S. Note, for example, the first full paragraph on page 22 of Applicants' specification. Claims 1 and 2 have been further amended to delete recitation of grain size of the carbonitride dispersed in the steel. In this regard, note, for example, the first full paragraph on page 18 of Applicants' specification, describing the grain size of the carbonitride "preferably" as being in the range of several to 100 nm.

Moreover, Applicants have amended claim 12 to recite a corrosion resistant, high strength austenitic stainless steel, consistent with parent claims 1 or 2. Particularly in view of amendment of the preamble of claim 12 to recite a corrosion resistant, high strength austenitic stainless steel, it is respectfully submitted that claim 12 should be considered with the elected Group I claims, and should not be a withdrawn claim.

In addition, Applicants are adding new claims 13-19 to the application. Claims 13 and 14, each dependent on claims 1 or 2, respectively recites that the at least one element is precipitated as M(C,N) carbonitride, where M is the at least one element; and recites that the stainless steel has 0.6% or less Si and 0.2% or less Mn. Note, for example, the second full paragraph on page 18, as well as the paragraph bridging pages 21 and 22, of Applicants' specification. Claim 15, dependent on claim 1

or 2, recites that the carbonitride has a grain size of 100 nm or less. See, for example, the first full paragraph on page 18, especially together with Fig. 5 and the description in connection therewith, for example, in the first full paragraph on page 30 of Applicants' specification. Note that the carbonitrides are precipitated and dispersed to pin intergranular transfer, with the result that the steel crystal grain growth during the consolidation process is controlled and a finer structure can be obtained; and that the present claims recite the average crystal grain size of the steel.

New claims 16 and 17, which are independent claims, recite a corrosion resistant, high strength austenitic stainless steel, formed by a method comprising the method steps respectively set forth in claims 4 and 5; moreover, in comparing claims 16 and 17 with claims 4 and 5, note that each of claims 16 and 17 include 0.045% or less of P, and 0.030% or less of S, in the listing of components of the powder; and recite that the austenitic stainless steel has carbonitride dispersed therein and the steel has an average crystal grain size of 1 μm or less. Claim 18, dependent on claim 16 or 17, recites that the carbonitride has a grain size of 100 nm or less, and that the steel contains 90% by volume or more of austenite phase. Claim 19 recites the same subject matter as in claim 12, but is dependent on claim 16 or 17.

The restriction requirement as set forth on pages 2 and 3 of the Office Action mailed May 2, 2003, is noted. Applicants affirm their election of the Group I claims. In addition to claims 1-3, it is respectfully submitted that claim 12 as presently amended, as well as newly added claims 13-19, are directed to the elected invention of an austenitic stainless steel, and should be considered on the merits in the present application.

Applicants respectfully traverse the restriction requirement between the austenitic stainless steel claims and the claims directed to a method of forming the austenitic stainless steel. Thus, it is respectfully submitted that the austenitic stainless steel claimed in claims 1-3, having an average crystal grain size falling within the specific range, can be produced by providing a mechanically milled powder with an average crystal grain size of 200 nm or less as in the method claims, and processing this mechanically milled powder, while the crystal grain growth is controlled by precipitating carbonitride during the consolidation. Thus, in providing the steel having crystal size according to the present invention, the method is an important tool therefor. It is respectfully submitted that, in view thereof, it would not constitute an undue burden on the Examiner to consider both the method claims and claims directed to the stainless steel in a single application. Accordingly, reconsideration and withdrawal of the restriction requirement is respectfully requested.

In any event, as indicated previously, Applicants affirm their election of the Group I claims.

Applicants respectfully traverse the rejection of their claims under the second paragraph of 35 USC §112, as set forth on page 4 of the Office Action mailed May 2, 2003, especially insofar as this rejection is applicable to the claims as presently amended. Thus, note that the basis for the indefiniteness rejection is use of the term "several" in Applicants' claims. It is noted that the range for the carbonitride, as in previously considered claim 1 is a "preferred" range, as disclosed on page 18 of Applicants' specification; and, moreover, as clear from Applicants' original disclosure as a whole, the precipitated carbonitride has the accomplishment of providing a stainless

steel having the specified crystal grain size as set forth in the present claims. By deleting the term "several" from the present claims, it is respectfully submitted that the basis for the indefiniteness rejection is moot.

Moreover, attention is respectfully directed to claim 15, reciting that the carbonitride has a grain size of 100 nm or less. See, for example, Fig. 5. Again, claim 15 does not use the term "several", and this avoids the basis for the indefiniteness rejection as set forth on page 4 of the Office Action mailed May 2, 2003.

Applicants respectfully submit that all of the claims now presented for consideration by the Examiner patentably distinguish over the teachings of the references as applied by the Examiner in rejecting claims in the Office Action mailed May 2, 2003, that is, the teachings of U.S. Patent No. 5,908,486 to Flinn, et al., and Japanese Patent Document No. 54-51922 (JP '922), under the provisions of 35 USC §103 .

It is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a corrosion resistant, high strength, austenitic stainless steel as in the present claims, including the specified components and containing carbonitride dispersed therein, and wherein, inter alia, the steel has an average crystal grain size of 1 μm or less. Note each of claims 1, 2, 16 and 17.

Moreover, it is respectfully submitted that these applied references would have neither taught nor would have suggested such austenitic stainless steel as in the present claims, wherein the stainless steel has been formed from a mechanically

processed powder, and wherein a value f from the equation set forth in claims 12 and 19 falls within a range of from 0.4 to 2.0. See claims 12 and 19.

In addition, it is respectfully submitted that the teachings of these applied references do not disclose, nor would have suggested, such austenitic stainless steel as in the present claims, and wherein the steel has been formed by processing as recited in claims 16 and 17.

Furthermore, it is respectfully submitted that these applied references do not disclose, nor would have suggested, such a corrosion resistant, high strength austenitic stainless steel as in the remaining claims, including (but not limited to) wherein the at least one element is precipitated as M(C,N) carbonitride, with M being the at least one element selected from the group consisting of Ti, Zr and Nb.

The invention as being considered on the merits in the above-identified application relates to an austenitic stainless steel which is balanced so as to be corrosion resistant and have high strength.

As described in the second paragraph on page 1 of Applicants' specification, austenitic stainless steel has widely been used as a structural material because of its excellent corrosion resistance and workability; however, the steel is low in strength, in comparison with other types of structural steel. Moreover, it is inferior to other types of steel in a specific corrosive environment where pitting or stress corrosion cracking is likely to occur. While requests have been rising for high strength structural materials, it has been difficult to achieve higher strength, while still achieving a high corrosion resistance of the austenitic stainless steel, and while also avoiding addition of specific

alloy elements, such as yttrium, which complicates the refining process, leading to an increase in production cost.

Against this background, Applicants provide a steel which is balanced in having improved strength as well as high corrosion resistance and toughness. Applicants have found that these benefits are achieved through use of a steel as in the present claims, having the carbonitride dispersed in the steel, and with the steel having an average crystal grain size of 1 μm or less. That is, through the steel having the relatively small average crystal grain size of 1 μm or less, having been obtained, e.g., by consolidating a powder having its structure ultra-fined by mechanical milling while controlling the crystal grain growth, e.g., through use of the carbonitride, higher strength and higher corrosion resistance are achieved with less reduction of toughness; and nano-scale fine crystal grain structure is uniformly distributed. Note the paragraph bridging pages 40 and 41, as well as the first two paragraphs on page 41, of Applicants' specification. The feature of the average crystal grain size of the steel is ensured by precipitating the at least one of Ti, Zr and Nb as M(C,N) carbonitride, where M is the at least one of Ti, Zr and Nb, rather than wherein the at least one element is precipitated as a relatively coarser structure of $M_{23}(CN)_6$; and/or wherein amounts of the various components in the powder used in forming the austenitic stainless steel satisfies the equation for f as in claims 12 and 19.

JP '922 discloses micronizing the grain size of austenitic stainless steel. The nitride and low carbon carbonitride of niobium in the stainless steel are solid-dissolved sufficiently in advance for precipitating finely in the austenitic stainless steel to micronize its grain size. As applied by the Examiner, this patent discloses that the

crystal grain size can be controlled between ASTM grain size No. 8 and No. 11. However, it is respectfully submitted that the ASTM grain size numbers 8, 9, 10, 11 and 12 correspond to grain sizes of 20, 14, 10, 7 and 5 μm, respectively. Such disclosure of ASTM grain size in JP '922 would have neither disclosed nor would have suggested, and in fact, would have taught away from, the relatively small average crystal grain size of 1 μm or less, as in the present claims, and advantages thereof.

It is respectfully submitted that JP '922 includes processing including subjecting the steel to solution heat treatment at 1250°-1300°C to dissolve nitride and carbonitride containing low amounts of carbon, while creating 5-15% delta-ferrite; quenching the steel to a temperature such that the nitride and carbonitride are kept dissolved; precipitating the nitride and carbonitride; and, by post-weld heat treatment; plastically working the steel, and recrystalization. In contrast, according to the present invention the stainless steel is manufactured by processing including providing a mechanically milled powder having specific characteristics; and either consolidating the powder at a relatively low temperature of 700°-900°C or consolidating the mechanically milled powder at this temperature and thermomechanical treating. According to the method of JP '922, the precipitation of nitride and carbonitride is conducted prior to plastic working, while according to the present invention the consolidation is conducted after the mechanical milling, which corresponds to the plastic working in JP '922. As can be seen, the method of making, as well as the steel made, differ according to the present invention and according to JP '922.

Flinn, et al. discloses austenitic stainless steels, wherein the alloys are strengthened by nanometer-size hollow oxides which serve as nucleation sites for

chromium-rich carbide precipitates within the alloy grains. The described alloys are produced by a method as described in column 2, lines 19-30, which provides large numbers of 7-10 nanometer-size hollow oxides which form nucleation sites for the precipitation of strengthening carbides and/or nitrides within the alloy grains. See also Table 6 in column 11 of this patent, describing broad and preferred ranges for components of the austenitic stainless steel. See also column 8, lines 35-40, of this patent, describing that for rapidly solidified Type 316VNO alloy, average grain sizes were 0.007, 0.007 and 0.010 mm, respectively, demonstrating that the processing of that alloy has enabled fine grains, stable to high temperatures, to be obtained.

As is clear at column 8, lines 35-40 of Flinn, et al., the crystal grain size is around a minimum of 7μm, much greater than the size of the austenitic stainless steel according to the present invention. It is respectfully submitted that Flinn, et al. would have neither taught nor would have suggested, and, in fact, would have taught away from, the present invention, including steel crystal grain size, as in the present invention, and advantages of the steel according to the present invention due, inter alia, to the crystal grain size.

Comments by the Examiner in the last full paragraph on page 3 of the Office Action mailed May 2, 2003, are noted. As can be seen in the foregoing, the "grain size of 10-11 ASTM" of JP '922 would not be "closely within [Applicants'] claimed range" as alleged by the Examiner, but would be a grain size much greater than the steel crystal grain size as in the present claims. Moreover, as seen in the foregoing, Flinn, et al. discloses a steel crystal grain size much greater than that in the present claims, and

thus would have taught away from the subject matter of the present claims, and advantages thereof.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims remaining in the application are respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR § 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to the Deposit Account No. 01-2135 (Case No. 500.41255X00), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

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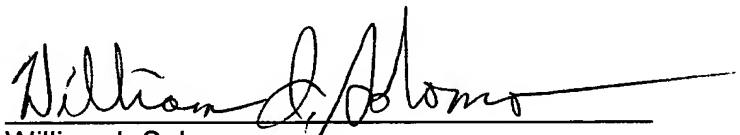

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